

ANNUAL REPORT

OF THE

**Canal Zone
Experiment Gardens**

**For the Fiscal Year
1939**



THE PANAMA CANAL PRESS
MOUNT HOPE, C. Z.
1939



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For additional copies of this publication address The Panama Canal, Washington, D. C., or Balboa Heights, Canal Zone.

LETTER OF TRANSMITTAL

CANAL ZONE EXPERIMENT GARDENS,
Summit, Canal Zone, *July 20, 1939.*

SIR: I present herewith and recommend for publication a Report of the Canal Zone Experiment Gardens for the fiscal year ending June 30, 1939.

Respectfully,
WALTER R. LINDSAY,
Director.

Mr. ROY R. WATSON,
Chief Quartermaster,
Balboa Heights, Canal Zone.

Through Mr. J. H. K. HUMPHREY,
First Assistant Chief Quartermaster.

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Mr. JAMES EDGAR HIGGINS

It is our desire to pay tribute to the memory of the late James Edgar Higgins who was Director of these Gardens from May 11, 1927 to June 1, 1936, at which time he was made Consultant in Plant Introduction and Utilization, a position he held until the time of his death on July 22, 1938.

Mr. Higgins devoted his entire life to tropical agriculture, having served in Hawaii, Puerto Rico, the Philippines, and the Canal Zone after receiving his Bachelor of Arts degree from Acadia University in 1895 and his Master of Science degree from Cornell University in 1898. He was regarded highly not only because of his agricultural work but also because of his unfailing interest in mankind and his readiness to receive those who came to him for counsel. We have lost not only a great man, but a friend.

PLATE I



JAMES EDGAR HIGGINS



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Annual Report

OF THE

CANAL ZONE EXPERIMENT GARDENS FOR 1939

By WALTER R. LINDSAY, *Director*

INTRODUCTION

Many people from Panama, the Canal Zone, and surrounding countries regularly keep in contact with the work going on at the Gardens, but no conscientious effort has been made by the Gardens staff outside of holding a mangosteen demonstration each year, to solicit the general public's attention. This year the Gardens were cleaned up and four picnic areas with open fireplaces, tables and benches were made available for the use of the public at any time. The public was also especially invited to visit the Gardens on three separate occasions. A talk and demonstration on budding and grafting proved to be very popular and the mangosteen demonstrations on August 27 and 29 alone drew several hundred people to the Gardens, including The Honorable Juan D. Arosemena, President of the Republic of Panama. The picnic areas will continue to be made available to the public each dry season, providing the privilege is not abused and plantings in the Gardens are not molested.

The last dry deason proved to be one of the dryest on record and took its toll of many valuable plants which had survived other dry seasons.

PERSONNEL

Upon the sudden death of Mr. J. E. Higgins, Consultant in Plant Introduction and Utilization, on July 22, 1938, the writer was promoted from Acting Director to Director of the Canal Zone Experiment Gardens. He had held the former position since June 1, 1936.

Mr. J. P. Keenan was promoted from Junior Landscape Architect to Assistant Director and Landscape Architect. He was Acting Director for four months during the Director's absence on leave in Hawaii and the continental United States.

The major portion of Mr. Keenan's time is devoted to the general supervision of landscape problems in the different Canal Zone townsites. He makes planting plans, for approval of the Chief Quartermaster, before any landscape job is started; inspects trees to be removed and supervises the tree pruning and maintenance landscape work being done by the District Quartermaster's forces.

Mr. Edward T. Stanwood retained his position as Nurseryman but was given increased responsibilities and more latitude for individual research.

Mr. Paul H. Allen, formerly employed as Manager of the Tropical Branch of the Missouri Botanical Garden's Station in Balboa, Canal Zone, was jointly hired by the Health Department and the Canal Zone Experiment Gardens, on March 1, 1939. Mr. Allen was to devote five days a week to his work with the Health Department and one day each week, plus such extra time as was required, to outline and supervise the work at the reorganized Balboa Orchid Gardens which was made a branch of the Canal Zone Experiment Gardens.

Mr. Robert L. Dwelle broke his service with The Panama Canal on August 31, 1938, to continue his landscape studies at Iowa State College.

COOPERATIVE PLANTING OF SUGARCANE

In direct accord with the aims and objectives of the Experiment Gardens is the varietal collection of sugarcane belonging to the United States Department of Agriculture which was transferred to the Canal Zone Experiment Gardens from their greenhouses in Washington. The agreement is that we provide land, labor and necessary equipment to grow the cane, and office and laboratory space for their technician who will devote his time to the care and study of the different cane varieties.

The following is a brief statement by Dr. E. W. Brandes, Principal Pathologist in Charge, Division of Sugar Plant Investigation, Bureau of Plant Industry, U. S. Department of Agriculture, on the cooperative work with sugarcane.

SUGARCANE

In cooperation with the Bureau of Plant Industry a reference collection of sugarcane varieties of the world was established at the Gardens in April 1939. Propagating material was sent from the quarantine greenhouse maintained by the Bureau at Arlington Experiment Farm near Washington, D. C.

The collection represents an effort to assemble examples of all ancestral forms of sugarcane, as well as varieties cultivated by natives, in the areas where sugarcane is assumed to be indigenous. The project has been in progress for nearly twenty years by exchange with other institutions and by first-hand collecting of "original varieties"; i. e., varieties not the product of modern breeding methods, and the accessions number about 500 clones.

The collection is for study of botanical relationships of the large number of plants of the genus *Saccharum* and related genera found

growing under natural conditions and under primitive conditions of cultivation. The principal purpose of the study is to determine the full range of natural variation within the group as a basis for developing useful new types by hybridization. The improvement of sugarcane in established areas of cane culture in mainland United States, Hawaii, and Puerto Rico is the chief aim of the work but further accessory benefits for the local and nearby sugar industries, begun by informal cooperation with the Gardens ten years ago, are contemplated as an adjunct to the project. It has been found possible to ship viable pollen of sugarcane satisfactorily by air in special containers and, therefore, selection of the Experiment Gardens as one of the repositories for the collection is expected to facilitate crossing of some of the varieties which bloom at different times of the year in different latitudes. The work on sugarcane at the Gardens is under the direction locally of Mr. Hans G. Sorensen, Agent, Division of Sugar Plant Investigations, Bureau of Plant Industry, U. S. Department of Agriculture.

EXPERIMENTAL FORESTRY PROJECT

(By J. P. KEENAN)

The United States Government is interested in furthering cooperative studies and experimental work covering various subjects in connection with the "good neighbor policy" practiced with the Latin American countries. Recently a number of projects of this kind were submitted by the Department of State to the ministers and ambassadors throughout Central and South America, for study and comment.

Among these projects were several of an agricultural nature. One of these was of particular interest to the Gardens. This project called for the establishment of a forestry experiment station for the purpose of studying the forestry problems of the various Latin American countries.

Through the good office of the American Minister in Panama, recommendations were made to the State Department to consider the establishment of such a station in the Canal Zone, in connection with the Experiment Gardens at Summit. In the recommendation submitted it was pointed out that the nucleus of such an experiment station is already in existence at the Gardens, and that studies and experiments in phases of forestry, which have been, and are now being conducted by the Gardens, could be considered as a foundation for the establishment of such a station. It was further pointed out that the central location of the Gardens at the crossroads of travel to the United States and Europe from the different Latin American countries afforded convenience for the interested visitors from these countries.

NURSERY OPERATIONS

The returns from the sale of plants this year exceeded that taken in during the 1938 fiscal year by over \$1,500.00 and exceeded the total sales for 1933 by \$5,000.00. This represents the sale of a rather large number of plants as the aim of the Nursery Unit is still to disseminate valuable economic and ornamental plants which have been tried out here, at as near cost as possible. Many plants are sold for as little as nine cents each while a few specimen palms and Ixoras which had been grown on for four or five years, sold for \$5.50 each.

Hardly any Java grass (*Polytrias praemorsa*) was available for dissemination from December through June because the grass areas in the Gardens were not watered during the severe dry season. Over 3,000 sacks of grass were disseminated during this period in 1938.

Due to the increased demand for specimen plants a number of stoloniferous palms, *Thujas*, *Ardesias*, and *Chalcas* were planted out in nursery rows. It is expected that they will be ready for distribution next planting season.

Table I shows the principal countries to which the plants were shipped during this fiscal year.

TABLE I.—1939-1940

Country	Fruit trees	Miscellaneous and ornamentals	Propagating material
Brazil			11
British Guiana	8		
Canal Zone	284	23,312	1,437
Colombia	180	129	3
Costa Rica	325	75	100
Cuba		7	1,155
Ecuador	66	3	
Egypt		10	3
Hawaii	6		5
India			10
Jamaica		23	
Netherlands W. I.	24	2	
New Zealand		1	
Nicaragua	207	10	
Panama	1,028	9,876	2,985
Paraguay	23		
Peru	2	10	
Puerto Rico		65	
San Salvador	13	2	
Tahiti		3	27
Trinidad	16	29	11
United States	7	200	81
Venezuela		3	2
Total	2,189	33,760	5,830

PLATE II
Views of the Balboa Orchid Gardens



FIGURE 1.—Approach



FIGURE 2.—Main entrance



FIGURE 3.—Informal plantings



FIGURE 4.—General view of the Gardens

BALBOA ORCHID GARDENS

The Panama Canal purchased the residence and the principal items of equipment at the Orchid Gardens, Balboa, from the Missouri Botanical Garden and took over the operation of the Gardens effective March 1, 1939. The Gardens are now being operated as a part of the Canal Zone Experiment Gardens and under the supervision of the Director.

Mr. Paul H. Allen, former Manager of the Tropical Branch of the Missouri Botanical Garden, has been retained on a part-time basis, as Curator of the Balboa Orchid Gardens. He supervises and carries to completion work which he outlines and has had approved by the Director. All correspondence relative to orchid exchanges or other matters pertaining to the Balboa Orchid Gardens should be addressed to the Director, Canal Zone Experiment Gardens, Pedro Miguel, Canal Zone.

Mr. Allen was asked to prepare a short article on the history and development of the Orchid Gardens. His article follows:

ORCHID GARDENS

During the month of March of the present year, The Panama Canal acquired from the Missouri Botanical Garden the tract of land and world-famous orchid collection developed by them under the title of the "Tropical Station." The grounds, situated on Morgan Avenue, near the Administration Building, have long been known to Isthmian residents by the more familiar name of the "Orchid Garden," whose varied fortunes have been watched with keen interest by many of the "Old-Timers" who have seen it grow from small beginnings. For the information of those not intimately familiar with the history of the grounds, it has been thought desirable to describe briefly the circumstances of the orchid collections, its earliest beginnings, as well as such subsequent changes as have directly effected the development of the grounds.

Some time prior to the World War, Mr. Charles W. Powell of Balboa began the collection of orchid plants, most of the first of which were taken from trees in the drowned portion of the Chagres River Valley covered by Gatun Lake. The collection was at first seemingly on the same basis as dozens of others which were doubtless made during the same period. His hobby continued however, and the collection came to the attention of Dr. R. A. Rolfe, of Kew Gardens in England, some time about 1919, at which time Dr. Rolfe requested that scientific specimens be prepared of representative samples of the plants and forwarded to England. Unfortunately, Dr. Rolfe fell into ill health and the specimens were never identified. Not in the least discouraged, Mr. Powell con-

tinued his work, sending further material to Dr. R. Schlecter of Berlin. Dr. Schlecter immediately recognized the importance of the plant collection, and encouraged Mr. Powell in every way to send in further specimens. An astonishing number of plants proved to be entirely new to science, which circumstance, coupled with Mr. Powell's care in the preparation of the specimens made him forever famous in the scientific world.

Mr. Powell's collection during these early stages had been, in spite of scientific acclaim, essentially a back yard project carried on during his spare time, on ground adjacent to his living quarters. Thus the matter might well have rested had not fate, in the person of George H. Pring, Superintendent of the Missouri Botanical Garden, appeared in 1923 to change the course of events. Mr. Pring at that time was returning from a four-months trip into Colombia, collecting orchids for the Botanic Garden, and stopped as a matter of routine to visit Mr. Powell. Being both extremely enthusiastic individuals, they promptly arranged for the exchange of several cases of plants, and in the process became fast friends. Mr. Pring was at the time tremendously impressed with the possibilities of establishing a sort of half-way station in the Canal Zone, where orchids could be imported from South America, held for a period of quarantine, and reshipped to St. Louis.

After much thought, discussion, and endless correspondence, Dr. George T. Moore, Director of the Missouri Botanical Garden, visited the Isthmus during 1926, at which time plans were completed for the development of the present grounds (Plate II. Figs. 1, 2, 3, 4). Land was granted by The Panama Canal, and the provision was made that Mr. Powell be given the position of Manager, that a residence be built for him on the grounds, and that his famous orchid collection be properly housed and cared for. Needless to say, Mr. Powell undertook the new project with the energy and enthusiasm so characteristic of him, and saw to successful completion the preliminary landscaping of the grounds, as well as the building of the residence. Hardly had these projects seen completion when Mr. Powell's health failed him, and he died, very suddenly, at the very beginning of the peaceful and interesting years which he had planned.

In the confusion following his death, the plants comprising his fine collection were seriously neglected, so much so in fact that Mr. Pring found the greater percentage of them dead when he arrived some six months later to take charge of the situation. It was found necessary to almost completely restock the grounds, a trip for that purpose being made in the company of Mr. A. A. Hunter, of Ancon. More than two months time was spent visiting all parts of the Republic readily acces-

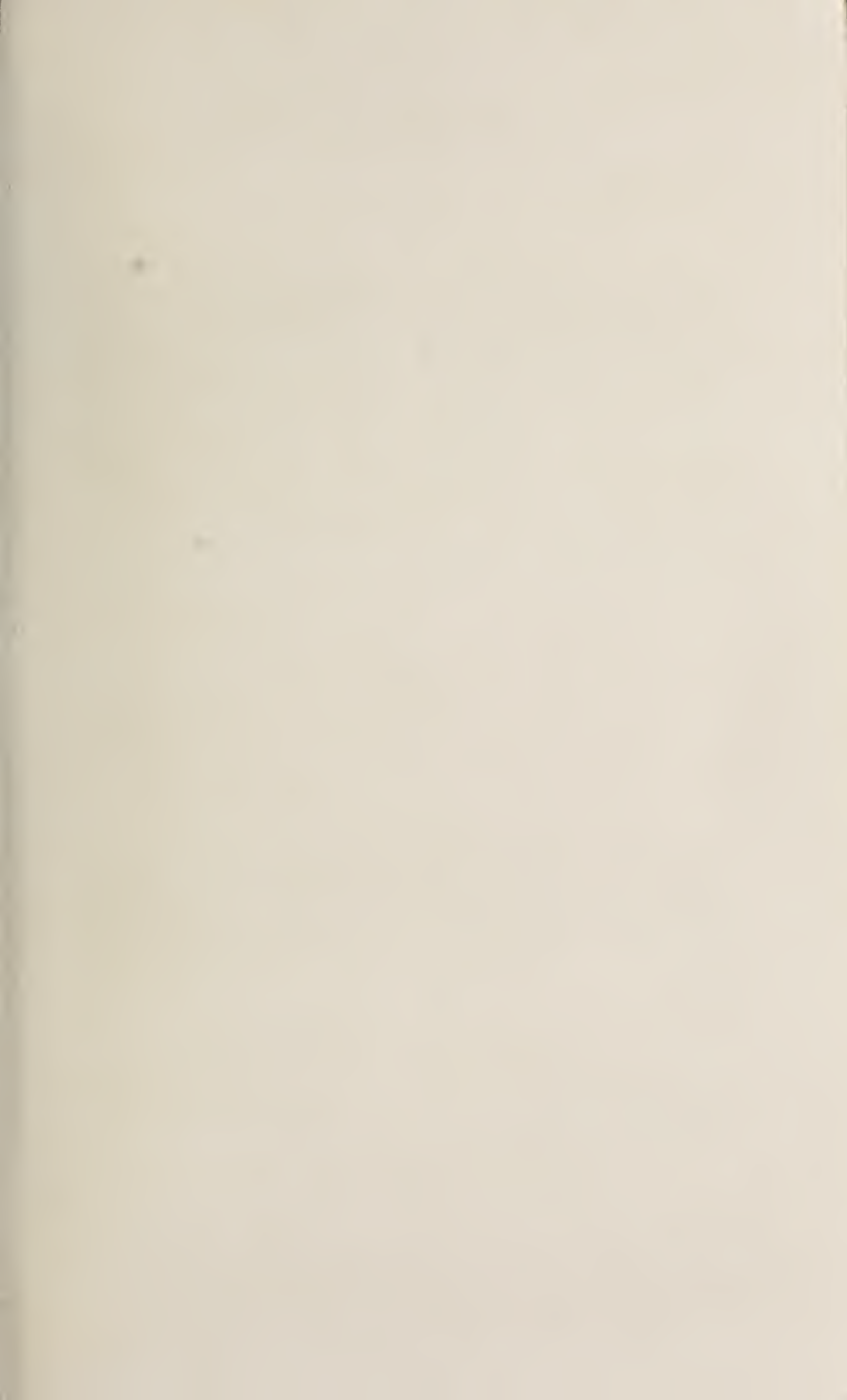


PLATE III



FIGURE 1.—Walk leading to the Orchid House past tree ferns and other attractive plantings



FIGURE 2.—General setting of the Orchid House



FIGURE 3.—The Orchid House



FIGURE 4.—Rear view of the Orchid House

sible at that time, gathering plants for the basis of the new collection. Mr. Pring found Mr. Hunter a kindred spirit and on his departure Mr. Hunter was installed as Manager in Mr. Powell's stead. Although Mr. Hunter was elsewhere employed he devoted practically his entire spare time to the continuance of the project, with the orchid collection ever maintained at its high standard. During the dry season of 1934-1935 the Missouri Botanical Garden sent an expedition to Panama, particularly specializing in the collection of plants to be found in the tree tops of the newly made Madden Lake area. After this area had been thoroughly covered further studies were conducted in parts further removed from the Zone, with attention concentrated on highland areas in the vicinity of Penonomé and El Valle, both in the Province of Cocle. Mr. Hunter's intimate knowledge of the country, as well as the fact that he personally conducted many of these trips undoubtedly were the deciding factors in the success of this expedition. Mr. Hunter died in April of 1935, leaving the station again without direction.

In 1936 Mr. P. H. Allen, a member of the '34-'35 expedition, was sent by the Garden to assume the position of Manager of the station left vacant by Mr. Hunter's death. As in the former instance, the interval had caused grave breaches in the orchid collection, particularly in the exotic plants needing more particular attention. Most of these plants have been replaced, largely through exchanges established with various fanciers both in the other Central and South American countries and in numerous parts of the East Indies. It was found necessary to replace all of the orchid racks dating from the time of Mr. Powell and Mr. Hunter, due to the ravages of termites. These old racks have been replaced with more permanent structures of galvanized iron pipe and cement. Walks (Plate III. Fig. 1) have been added, with the view of providing more easy access to the displays of flowers provided from time to time. A small pool (Plate IV. Fig. 1) has been built near the entrance gate, flanked with ferns and palms, for the display of tropical varieties of hybrid water lilies, adding greatly to the interest of the grounds. It was soon found that many of the newly imported plants, both species and hybrids, did not thrive when left exposed to the full force of the rains, so that a glass-roofed structure (Plate III. Figs. 2, 3, 4) was found necessary which, with the addition of screened sides, provides ideally-controlled conditions for the more valuable plants of the collection. During this same period the Missouri Botanical Garden recognized the increased opportunity provided by better roads in continuing their botanical explorations of the country. During the years 1936-1939 some 20,000 specimens have been taken, which have added greatly to the sum of knowledge of the plants of Panama.

Unfortunately, the Garden found that an increasing financial burden in the United States made it impossible to continue the support of the station. For a time it looked as though the entire project would have to be abandoned, but through the careful planning of Mr. J. H. K. Humphrey, First Assistant Chief Quartermaster, it was found possible to incorporate the grounds as a part of the Canal Zone Experiment Gardens. This is felt to be a very natural and logical arrangement, being analogous to the arrangement in Jamaica between Hope and Castleton gardens. Since the project has come under the Canal Zone management the improvement of grounds has continued, with the installation of a new pergola (Plate IV. Fig. 2) for the growing of plants adapted to conditions of shade. Ample humidity has been provided for by the addition of a pool and fountain (Plate IV. Figs. 3, 4) and it is felt that this will fill a long-felt need. At the present time the grounds are being carefully relandscaped, with the removal of unsightly or undesirable plants, and their replacement with things of more desirable nature.

LANDSCAPE UNIT

The Landscape Unit which became effective on August 1, 1937 and was discussed at length in the 1938 Annual Report, was abolished on July 1, 1938. It is believed that this unit made a very creditable showing for itself during its eleven months of existence but it was thought best to have the District Quartermasters do all work in their districts. The pruning gang was thus divided between the Atlantic and Pacific districts and the planting gang laid off. Mr. Keenan continues, however, to supervise all pruning, landscape planting, and advises in other landscape problems.

LANDSCAPE WORK

(By J. P. KEENAN)

The establishment and organization of the Landscape Unit of the Canal Zone Experiment Gardens was discussed at some length in the 1938 Annual Report. Several outstanding changes have been made in this organization during the past year.

Effective July 1, 1938 the labor forces of the unit with the exception of those engaged in the landscape planting of the Gamboa townsite, were transferred to the various Quartermaster districts. This change was made to facilitate the more economical and efficient distribution of labor in the several districts where landscape work was being executed. The supervision, planning, and rendering of estimates was delegated to the Assistant Director, Landscape Architect of the Gardens.

In October 1938, the landscape planting of the new Gamboa townsite was completed. At the time of writing, this townsite presents one of the most attractive landscape pictures on the Canal Zone. It is interesting to note that the percentage of plant failures for the landscape project were reduced from 5 to $1\frac{1}{2}$ percent. It is believed that these gratifying results may be attributed to the closer supervision of the planting by a trained foreman and also to the better planting materials received from the nursery.

In accordance with the Governor's Circular of May 5, 1938, which required the Landscape Unit of the Experiment Gardens to supply estimated costs of grass and planting services for all building construction projects, 54 estimates for the various projects were submitted during the past fiscal year. This arrangement has greatly facilitated the planning of future landscape work. It allows landscape plans to be made in advance of the time of planting, which in turn helps the nursery to plan for the propagation of the necessary planting material for each project.

It is felt that another important advance was made in the landscape planting during the past fiscal year. The use of specimen plants was introduced. Although the supply of this material was limited, several houses in the various landscape projects were completed with specimen plants so that comparative cost studies could be made between the initial and maintenance costs of the two types of planting. The immediate effect obtained from the use of specimen plants is more pleasing than that obtained from the use of cheaper nursery material but it is yet too soon to say whether or not the lower maintenance cost of these specimen plants will prove to make this type of planting practicable. Further studies will be made during the next planting season (May to September) as the nursery will then have a larger stock of specimen plants available.

Various landscape plans were executed during the past year. Six landscape projects were completed during the year; four others were started and are nearing completion at the time of this writing.

The more important projects completed and near completion are:

- (a) Landscaping of the new quarters at Gatun.
- (b) Landscaping of the new quarters at Herrick Heights, Ancon.
- (c) Landscaping of the new quarters at Gavilan Fill, Balboa.

The outstanding relandscaping project is the relandscaping of the Balboa Prado. This landscaping is designed to render a semiformal effect, softened by the use of some of the most beautiful flowering trees in the tropical world. It is believed that the completed project will render the Prado one of the most attractive landscapes in this part of the world.

ANNUAL REPORTS

It was explained in last year's Annual Report that money had been made available for the publication of all unpublished Annual Reports of the Canal Zone Experiment Gardens. These reports have all been printed and copies have been sent to individuals and institutions whose names appear on the regular mailing list of the Gardens.

We are grateful for the many valuable publications which have been received from institutions receiving our Annual Report.

SPANISH EDITION OF THE NURSERY PRICE LIST

To meet an increasing demand for a price list written in Spanish, of the plants obtainable at the Canal Zone Experiment Gardens, a partial translation of our most recent Price List of Plants and Nursery Materials was made by the official translator for The Panama Canal. Copies of this translation have been sent to inquiring parties in Central and South America, with a resultant increased demand for plants from these regions.

PATHS AND ROADS

All paths and macadamized roads throughout the Gardens were heavily surfaced with oil and finely-crushed rock during the dry season (Plate V. Fig. 1). Bamboo Road, which had formerly been only a narrow dirt road, was built up with slag and broken rocks from the Summit Quarry. The whole of this road was then surfaced with oil and sand.

The cost of keeping the paths free from grass and weeds has been reduced considerably by the use of commercial arsenic (Arsenic Trioxide) and caustic soda. The former method of cleaning, by burning, cost slightly over fifty dollars for each cleaning which would last for approximately three months, whereas the cost of labor and materials for a very thorough job of spraying with arsenic and soda is only seventeen dollars. Under all probabilities there will be sufficient arsenic accumulated in the paths, from a number of treatments, to make them toxic to plant growth. The number of spray treatments will then be reduced to one or two a year.

The formula for preparing a stock solution of arsenic and soda is as follows: Mix 100 pounds of caustic soda with 25 gallons of water in a 50-gallon barrel. The heat involved will dissolve the soda. To this solution add 200 pounds of Arsenic Trioxide and enough water to make a total of fifty gallons of solution.

One gallon of stock solution diluted with twenty gallons of water makes a very effective spray for killing most grasses and weeds. Guinea grass (*Panicum maximum*) as well as some other coarse grasses, require more concentrated solutions. One gallon of stock solution to ten gallons of water has been found to kill our most vigorous grasses and weeds.

Caution should be taken in handling the solution as sufficient arsenic may be absorbed through the pores in one's hands to cause severe arsenic poisoning.

PICNIC AREAS

(By J. P. KEENAN)

A conservative development of the recreational possibilities of the Gardens has long been under consideration. In January 1939, the Gardens' staff finally chose various places suitable for picnic areas. One site was located on the bank of No. 4 lily pond under the spreading branches of a large Waringiana fig tree (*Ficus waringiana*) and surrounded by attractive shrubbery and flowering trees. Another site was located on the top of Mango Hill under an enormous old mango tree. This site afforded an unobstructed view of a large portion of the Gardens and the attractive jungle landscape of the surrounding countryside. A third location was picked in a grove of mango trees surrounded by an open park area almost in the center of the Gardens. This location offers attractive vistas (Plate VI. Fig. 1) in every direction. The fourth location was picked for its seclusion and the attractive greenery of the immediate local setting. This site is located among the tall bamboos below Lily Pond No. 3 where the ever-present cool breezes and the dense shade of the large swaying bamboos afford rest and relaxation.

Each picnic site was equipped with a table and two benches capable of seating 10 to 12 people comfortably; a small open grill-type fireplace and a covered refuse can.

The public response to the construction of these picnic sites was gratifying to the Gardens and proved conclusively that the recreational facilities offered by the Gardens were both appreciated and needed. Over 400 people availed themselves of the use of these areas during the dry season months.

VISITORS' DAYS

(By J. P. KEENAN)

To better acquaint the general public with the work carried on at the Gardens, the first Annual Visitors' Day was inaugurated on Sunday, March 19. It has been the policy of the Gardens to welcome visitors at

all times, but it was felt that a special day set aside for the purpose of devoting entire time and facilities of the Gardens to the entertainment and enlightenment of the public would not be amiss.

A display of the many fruits and plants of economic value by the Gardens was arranged at the greenhouse so that all visitors could examine them. Each display had a card giving a condensed description of the plants or fruits together with their uses and other information which would be of general interest. Competent guides were on hand to conduct all visitors through the Gardens. Interesting trees and shrubs, together with the several experimental projects, were pointed out and explained.

During the course of the day a short talk was given by the Acting Director, who outlined the history of the Gardens, together with the numerous projects and studies made in the past. Experiments being carried on at the time and the proposed future studies and development were also discussed.

Mr. E. T. Stanwood, the Garden's nurseryman, also gave a most instructive lecture and demonstrated the various methods of propagation, spraying, fertilizing and pruning of plants.

Through the cooperation of the Panama Railroad the noon train from Colon and the evening train from Panama stopped at Summit to discharge and pick up visitors from the Atlantic side of the Isthmus. Seventy persons from the Atlantic side availed themselves of this means of transportation to the Gardens.

According to our records, over 800 people visited the Gardens on Visitors' Day. The interest shown by the public in these activities would seem to justify the inclusion of such a day in the Garden's yearly program.

THE GAMBOA FLOWER SHOW

(By E. T. STANWOOD)

In March 1939, a flower show was held in the Gamboa Clubhouse under the auspices of the Gamboa Women's Club. Many attractive exhibits were placed by the amateur gardeners throughout the Canal Zone, together with very beautiful floral displays by several commercial florists of the Canal Zone and the Republic of Panama.

The Canal Zone Experiment Garden's display of various rare ornamental and economic plants received favorable comments from the numerous visitors who attended the show. A special display of several varieties of colored water lilies grown at the Gardens, arranged in a specially constructed and very realistic lily pond in the center of the exhibits attracted considerable attention. A very interesting lecture on

PLATE IV



FIGURE 1.—Small water-lily pond near the entrance to the Balboa Orchid Garden



FIGURE 2.—General view of the new pergola



FIGURE 3.—Interior view of the pergola



FIGURE 4.—Pool in the pergola

"The Flowering Trees of the Canal Zone and Panama," was given by Mrs. H. H. Evans, of Balboa Heights. An exhibit of oil and water-color paintings of these flowers, painted by Mrs. Evans, was also displayed.

Several exhibits of North American flowers which are very difficult to grow in the tropics were displayed; outstanding among these were nasturtiums, hydrangeas, and pansies.

According to available records, this flower show was the first to be held in the Canal Zone. Considerable credit is due the members of the Gamboa Women's Club for the excellent, well-planned show. It is hoped that a show of this kind will become a yearly event. The interest stimulated by the show among the Canal Zone and Panama residents was reflected in the increase in visitors at the Gardens.

NEW BENCHES

In exchange for plants and service rendered the Locks Division, the Gardens received several hundred feet of "T" iron and strips of low-grade steel which were worn and of no further use to the Locks Division. The blacksmith at the Pedro Miguel Locks very kindly cut notches in pieces of "T" iron, which were 36 inches long, so that the bases of the T's might fit in them to form a flat bench (Plate V. Fig. 2). These benches were painted with tar and placed on concrete bases in our greenhouses. The flat steel strips which were 30 feet long by 6 inches wide and one inch thick, were conveniently perforated with holes approximately one and one-half inches in diameter and two inches apart. These strips were thoroughly painted with tar and laid on steel cross-pieces supported on concrete bases. These benches are the most substantial greenhouse benches that have ever been made at the Gardens, and with a minimum amount of care should last for many decades. The remainder of the benches in our greenhouses are made of pieces of two-by-four pine wood, nailed to pieces of four-by-four cross-pieces and supported on concrete blocks. The entire woodwork in these benches has to be replaced each year or year and a half. It is hoped that we can eventually get enough cast-off steel to replace all of our wooden benches.

NEW MACHINES

A "De Wald" circular power saw was transferred to the Experiment Gardens by the Constructing Quartermaster Division. This saw has already saved us many tedious hours of hand sawing boards for making seed flats and shipping crates.

Another new "Gravely" tractor mowing machine was purchased by the Gardens. This makes two of these machines in operation at the

Gardens and they are proving to be very efficient and economical to operate. One with a 42-inch blade is economically used to cut down the grass and weeds in the nurseries. A new tractor has been ordered but delivery will not be made until early in the 1940 fiscal year.

IMPORTANT INTRODUCTIONS

One of the important introductions of the year was that of the IC2 variety of banana which was sent to the Gardens by Dr. F. J. Pound, of the Department of Agriculture, Trinidad. This variety is reported to be practically immune to the common banana diseases, besides possessing the qualities required of the commercial Gros Michel. Six plants were introduced and they are all growing exceptionally well.

The introduction of the *Cinchona ledgeriana* plants, discussed elsewhere in this report, may some day prove to be the beginning of a new industry in the cooler provinces of Panama. It is regretted that so many of the plants died in transit but it is hoped that the few plants which survived will prosper and become the source of more propagating material.

The following table shows the number of species of seeds or plants received from individuals and institutions:

TABLE II.

	Species of seeds	Species of plants
Royal Botanic Gardens, Trinidad, B. W. I.-----	2	1
Mr. David Barry, Jr., Los Angeles, California-----	23	-----
Mr. J. B. Shropshire, Ancon, C. Z.-----	5	4
Mrs. Margaret A. Langlois, Nassau, Bahamas-----	9	-----
Mr. Paul Allen, Balboa, C. Z.-----	7	11
Mr. Wilson Popenoe, La Lima, Spanish Honduras-----	-----	6
Mr. W. Paul Phillips, 316 E. Church St., Orlando, Florida-----	26	3
The Coconut Grove Palmetum, Coconut Grove, Florida-----	3	-----
Rev. Leon L. Loofbourow, Balboa Union Church, Balboa, C. Z.-----	2	-----
Merkel Brothers, Box 537, Boynton, Florida-----	-----	3
Mr. F. G. Walsingham, Harvard University, (Soledad) Cienfuegos, Cuba-----	7	-----
U. S. Department of Agriculture, Washington, D. C.-----	10	82
Mrs. Dorothy Fowler, Winnipeg, Manitoba, Canada-----	3	-----
Mr. Harrison W. Smith, Papeari, Tahiti-----	10	12
Mr. Walter N. Bangham, Botanist, Dolok Merangir, Sumatra-----	2	-----
Dr. H. Pittier, Box 255, Caracas, Venezuela-----	7	-----
Mr. Walter Holt, Box 3319, Honolulu, T. H.-----	3	-----
Director of Gardens, Botanic Gardens, Straits Settlements, Singapore-----	10	-----
Foster Gardens, Honolulu, T. H.-----	20	9
Isabella Lindsay, Haiku Maui, T. H.-----	10	17
Mr. James C. Lindsay, Haiku Maui, T. H.-----	8	5
Dr. Edward M. Ehrhorn, Box 2456, Honolulu, T. H.-----	3	-----
Hawaii Experiment Station, Honolulu, T. H.-----	-----	4



FIGURE 1.—Macadamized road flanked with
graceful palms, *Euterpe edulis*



FIGURE 2.—Benches made from "T" iron

REPORT OF A NEW CITRUS DISEASE

On April 15, 1939, Dr. H. S. Fawcett, Professor of Plant Pathology, Citrus Experimental Station and Graduate School of Tropical Agriculture, Riverside, California, wrote concerning a mildew-like organism on young citrus seedling which we had called his attention to when he visited the Canal Zone Experiment Gardens in the Spring of 1937. He reported that Dr. C. L. Shear, former mycologist in the United States Department of Agriculture, "found this to be a very interesting organism which had probably not been reported before on citrus." He considered it to be a fungus somewhat related to *Hypochnus*. The organism attacks young citrus trees in the nursery beds, causing the leaves to dry and eventually drop off. During the early stage of attack the citrus appear as though they were covered with mildew. The disease is extremely severe in wet weather and it is not uncommon for a whole nursery bed to become infested during the interval of a few days. Experiments have proven that infestations are not as common or as severe when the nursery beds are made on hillsides where it is easier to allow for proper drainage. It has also been found that 4-4-50 Bordeaux Mixture is effective in controlling this disease and that many badly-infested plants will recover after one or two applications of Bordeaux.

CONTROLLING THE FRUITING SEASON OF PINEAPPLE

It has been found that a small quantity of calcium carbide placed in the center of pineapple plants will cause them to flower in 80 or 90 days after treatment; within another 90 days the fruits are ready for harvesting. The significance of this discovery is not readily appreciated unless one is acquainted with the difficulties pineapple companies have encountered when the fruits from several hundred and, in some cases, several thousand acres all ripened in a period of a month or six weeks. By treating a certain number of plants with carbide each week it is possible to control the volume of fruit entering the factories at any time. Practically all plants treated on the same day will have their fruits ready for harvesting at the same time, thus eliminating the necessity for repeating return to harvest each field.

In small plantings of pineapples such as those found here in the Canal Zone and Panama, the proper application of carbide would insure a steady supply of fruit for the local markets throughout the year. The Gamboa Penitentiary has tried this with success during the past year.

SEEDINESS IN PINEAPPLES

The question of what causes pineapples to produce seeds in some parts of the world and not in others, has long been of interest and of considerable economic importance. The Smooth Cayenne, or commercial Hawaiian pineapple, as well as other introduced varieties, will rarely produce seeds in Hawaii although they generally contain seeds in other countries. Seedy pineapple fruits are practically worthless for canning purposes and for that reason steps have been taken to determine the cause of the seed.

Dr. J. L. Collins, Geneticist at the Pineapple Producers Cooperative Association, Honolulu, Hawaii, visited the Canal Zone Experiment Gardens for a few days in September 1939, when he was on his way to Paraguay, via Central America, Trinidad and South American countries which grow pineapples. An experiment was commenced at that time in which we hope to determine if humming birds, bees, or other such agents were responsible for cross-pollinating the pineapple blossoms. Cages made from mosquito netting and supported by a wire frame, were securely tied around 50 young pineapple fruits before any of the flower buds opened and were allowed to remain in this manner until after the flowering period had passed and the fruits were well matured. When the fruits ripened, an accurate count was made of the number of seeds in each of an equal number of covered and untreated or "check" fruits. Table III shows the results of the seed count. The first 32 fruits in each column in the table were of the Monte Lirio variety, while the other 14 fruits were of the Smooth Cayenne, Taboga, Cowboy, Queen, Monte Lirio, Hilo Cayenne, Ruby, Congo, Pernambuco, Wild Brazil, Marietus and Natal varieties.

TABLE III.

Fruits covered with mosquito netting					Uncovered fruits				
No.	Weight		No. of seeds	Harvested	No.	Weight		No. of seeds	Harvested
	Lbs.	Ozs.				Lbs.	Ozs.		
1	0	9	2	2-23-39	1	1	7	9	2-23-39
2	0	13	0	2-23-39	2	1	10	0	2-23-39
3	0	14	0	2-23-39	3	0	12	1	2-23-39
4	1	0	17	2-23-39	4	0	8	4	2-23-39
5	0	13	1	2-23-39	5	0	15	0	2-23-39
6	0	8	0	2-23-39	6	2	0	0	2-23-39
7	2	7	2	2-23-39	7	1	7	0	2-23-39
8	2	5	0	2-23-39	8	0	14	0	2-23-39
9	0	13	0	2-23-39	9	0	12	0	2-23-39
10	0	14	11	2-23-39	10	1	12	0	2-23-39
11	1	7	3	2-23-39	11	0	12	5	2-23-39
12	2	4	0	2-23-39	12	5	0	1	2-23-39
13	4	0	8	2-23-39	13	4	10	0	2-23-39
14	0	15	3	2-23-39	14	3	0	0	2-23-39
15	1	6	6	2-2-39	15	4	6	69	1-26-39
16	5	0	14	2-9-39	16	5	13	74	1-26-39
17	5	7	24	2-9-39	17	5	11	4	1-26-39
18	3	12	20	2-9-39	18	4	13	29	1-26-39
19	3	8	50	2-9-39	19	3	10	1	1-26-39
20	3	14	17	2-9-39	20	3	13	14	1-26-39
21	1	11	6	2-9-39	21	4	5	31	1-26-39
22	3	3	23	2-9-39	22	4	10	40	1-26-39
23	3	5	30	2-9-39	23	3	5	45	1-26-39
24	3	2	14	2-13-39	24	3	7	2	1-26-39
25	3	3	54	2-13-39	25	2	13	13	1-26-39
26	4	4	16	2-13-39	26	3	1	50	1-26-39
27	4	12	11	2-13-39	27	4	10	0	1-26-39
28	4	11	52	2-13-39	28	5	3	86	1-30-39
29	3	7	15	2-13-39	29	4	9	4	1-30-39
30	2	8	0	2-13-39	30	5	4	3	1-30-39
31	2	9	102	2-13-39	31	5	3	6	1-30-39
32	3	11	61	2-13-39	32	4	11	4	1-30-39
33	1	3	17	2-13-39	33	4	13	14	1-30-39
34	2	13	38	2-13-39	34	4	13	6	1-30-39
35	2	2	32	2-13-39	35	4	1	16	1-30-39
36	4	8	57	2-13-39	36	4	1	3	1-30-39
37	3	2	43	2-13-39	37	5	1	9	1-30-39
38	4	4	130	2-13-39	38	4	13	14	1-30-39
39	3	7	15	2-13-39	39	4	3	5	1-30-39
40	3	2	39	2-13-39	40	2	6	5	2-9-39
41	4	5	88	2-13-39	41	2	11	4	2-9-39
42	3	0	16	2-13-39	42	4	0	5	2-9-39
43	2	6	40	2-13-39	43	3	8	1	2-9-39
44	2	3	8	2-13-39	44	5	2	54	2-9-39
45	3	14	242	2-13-39	45	4	0	8	2-9-39
46	3	15	2	2-13-39	46	3	3	2	2-9-39
Total seeds.... 1,329					Total seeds.... 641				

Many species of bees and humming birds were frequently seen visiting the uncovered blossoms. One species of ant frequented uncovered

fruits and was also seen passing through the mosquito netting cages. They seemed to secure nectar from the base of the blossoms but were never seen entering the flowers.

It is difficult to account for the greater number of seeds in the covered fruits than in the "checks" but it is possible that the ants are responsible for cross-pollinating the flowers. The covered fruits being more shaded might consequently be more desirable for the ants to work on.

We are planning to continue this experiment with a limited number of plants which will be planted in containers of sterilized soil and will be kept off the ground on ant-free benches.

ROOT PROMOTING AGENTS

(By E. T. STANWOOD)

Several plant hormone preparations used in the root development of cuttings have recently appeared on the market. These preparations have been of great benefit to propagators who have experienced difficulty in rooting certain plants.

Many types and concentrations of plant hormones have been experimented with by the Nursery Unit of the Experiment Gardens. The first type used was in the form of a paste which was applied to the top of the cuttings. Later experiments were with various concentrations of hormones dissolved in water. Cuttings were placed in these hormone solutions for various lengths of time. No advantage in root growth could be noted when these hormones were used.

Plate VI. Fig. 2, shows *Ixora* cuttings (*Ixora coccinea*) which had been treated with "Rootone" and those which were untreated. It can easily be seen how much more advanced the treated cuttings were at the end of 72 days. It would be desirable to mention that plants established by treatment with any plant hormone will not be superior in quality to those untreated. The greatest benefit derived from the use of these preparations lies in the quicker root development which in turn gives security in the establishment of the plants.

At this time there is on the market several types of preparations which are of various strengths. Through research the manufacturers have established scales or tables which can be depended upon in guiding one in giving propagating material the proper treatment for the best results.

WATER CULTURE

(By J. P. KEENAN)

During the past dry season preliminary studies were made of the various methods of growing plants by means of water culture (Hydroponics), which have been developed at several of the Experiment Sta-

PLATE VI



FIGURE 1.—View of the Gardens as seen from one of the picnic areas



FIGURE 2.—Ixora cuttings (4 on left) which had been treated with "Rootone" as compared with those which were not treated

tions in the United States. These studies were carried on so that notes could be accumulated which would help in the development of the more extensive experiments in the various uses of water culture which will begin in the near future.

From the data on hand it is felt that combinations of methods may be used which will give the most efficient results for the specific location, climate and physical conditions under which such experimental work will be carried on. Special attention was given to experiments in which plants were grown in various mediums such as sea sand, river-bed sand, straw, shavings, moss, various fibers and sterile soil. It is not believed advisable to make any reports on the results obtained at this time as further studies must be made during the rainy season when the climatic conditions are so greatly changed.

CINCHONA (By J. P. KEENAN)

On December 2, 1938, a shipment of 1,000 young Quinine Bark trees (*Cinchona ledgeriana*) were received by the Gardens from the United States Department of Agriculture. These plants were placed with several responsible planters in the Volcan and Boquete regions of Panama.

Upon unpacking the shipment it was found that 502 of the young plants were dead, 102 of the plants were in doubtful condition, and 396 plants were in apparently good condition. Despite the fact that the 102 plants which were in poor condition were placed in the greenhouses and given special care, they were all dead in a few days. This brought the mortality up to 604 plants out of the thousand plants received. This loss in shipment was very discouraging; however, according to reports of shipments made to Puerto Rico a high mortality was also noted.

The Panamanian Government furnished an airplane to transport 380 of the 396 plants to the Boquete and Volcan regions, where they were immediately distributed to the planters. As the plants were received at the beginning of the dry season, it is likely that many of them suffered from the lack of sufficient water. Some of the planters report, however, that they have succeeded in establishing small numbers of these trees and they seem to be prospering. From these few trees it is hoped that planting material may be obtained to establish more trees in these regions.

The Gardens also intend to try to make other introductions of this species. It is believed that the greatest chance of success lies in the importation of seeds and the establishing of a cooperative nursery in the regions where they will be planted.

TRIP TO HAWAII

The Director entered on a four months vacation on November 23, 1938. Approximately two months of this time was spent in Hawaii and much valuable information was obtained while visiting the Foster Gardens, Experiment Stations, C. C. C. Camps, private gardens and commercial nurseries.

Special thanks are due to Dr. Harold L. Lyon and Mr. Colin Potter of the Hawaii Sugar Planters' Association for their assistance in arranging trips, caring for plants which they donated as well as those which were collected on visits to other nurseries and finally for the packing and shipping of the plants after I had left the Islands. Many valuable plants were also received from the Haiku Nursery, owned by Miss Isabella Lindsay, from Mr. James C. Lindsay, and from the Bowers Tropical Nursery.

Table IV lists all the plants of which propagating material was received from Hawaii, the source from which these came and the purpose of their introduction.

TABLE IV

<i>Introduction</i>	<i>Source</i>	<i>Purpose</i>
Ravenala madagascariensis.....	Foster Gardens, Honolulu	Ornamental
Bauhinia sp.....	Haiku Nursery	Ornamental
Long-staple cotton.....	Haiku Nursery	Fiber
Annona squamosa.....	Haiku Nursery	Fruit
Citrus sp.....	Haiku Nursery	Fruit
Diospyros ebinaster.....	David Fleming	Fruit
Kigelia sp.....	Haiku Nursery	Ornamental
Amaryllis sp.....	Haiku Nursery	Ornamental
Scabiosa sp.....	Haiku Nursery	Ornamental
Specularia speculum.....	Haiku Nursery	Ornamental
Kunzea peduncularis.....	James C. Lindsay	Ornamental
Bignonia sp.....	Foster Gardens	Ornamental
Casuarina sp.....	C. C. C. Camp, Olinda	Ornamental
Calliandra haematoma.....	Foster Gardens	Ornamental
Cleome sp.....	Foster Gardens	Ornamental
Bignonia sp.....	Foster Gardens	Ornamental
Clitoria sp.....	Haiku Nursery	Ornamental
Montanoa sp.....	Foster Gardens	Ornamental
Ochna kirkii.....	Foster Gardens	Ornamental tree for exposed beaches
Tournefortia argentea.....	Foster Gardens	Ornamental tree for exposed beaches
Sophora tomentosa.....	Foster Gardens	Ornamental
Antigonon leptopus.....	Foster Gardens	Ornamental
Strelitzia reginae.....	Foster Gardens	Ornamental
Hyophorbe amerculis.....	Foster Gardens	Ornamental palm
Archontophoenix alexandrae.....	Foster Gardens	Ornamental palm
Hyophorbe verchaffelti.....	Foster Gardens	Ornamental palm
Cocos Australis.....	Foster Gardens	Ornamental palm
Platyserium grande.....	Dr. Edward M. Ehrhorn	Ornamental palm

TABLE IV.—Continued

<i>Introduction</i>	<i>Source</i>	<i>Purpose</i>
<i>Passiflora edulis</i>	James C. Lindsay	Fruit
<i>Posoqueria</i> sp.	Foster Gardens	Ornamental
<i>Carica papaya</i> - var. Solo.....	Haiku Nursery	Fruit
<i>Prosopis chilensis</i>	Foster Gardens	Stock feed
<i>Physalis peruviana</i>	James C. Lindsay	Fruit
<i>Pachira fastuosa</i>	Haiku Nursery	Nut
<i>Cupressus</i> sp.	Foster Gardens	Ornamental
<i>Cordia sebestena</i>	Foster Gardens	Ornamental
<i>Pritchardia</i> sp.	James C. Lindsay	Ornamental palm
<i>Solanum nigrum</i>	James C. Lindsay	Fruit
<i>Pandanus tectorius</i>	James C. Lindsay	Ornamental
<i>Acacia koa</i>	James C. Lindsay	Ornamental
<i>Zephyranthes</i> spp.	Haiku Nursery	Ornamental
<i>Hibiscus</i> hybrids.....	Haiku Nursery	Ornamental
<i>Hibiscus</i> hybrids.....	Mr. Bush, Honolulu	Ornamental
<i>Eugenia malaccensis</i>	Foster Gardens	Fruit and ornamental
<i>Mangifera indica</i>	Hawaii Experiment Station	Fruit
<i>Litchi chinensis</i>	Hawaii Experiment Station	Fruit
<i>Licania rigida</i>	Hawaii Experiment Station	Oil
<i>Euphoria longan</i>	Haiku Nursery	Fruit
<i>Cibotium chamissoi</i>	James C. Lindsay	Ornamental
<i>Ficus carica</i>	Haiku Nursery	Fruit
<i>Plumeria</i> sp.	Foster Gardens	Ornamental
<i>Caryota cummingii</i>	Foster Gardens	Ornamental palm
<i>Ochrosia elliptica</i>	Foster Gardens	Ornamental palm
<i>Strelitzia nicolai</i>	Foster Gardens	Ornamental palm
<i>Strelitzia reginae</i>	Dr. Edward M. Ehrhorn	Ornamental palm
<i>Pimenta officinalis</i>	Haiku Nursery	Spice
<i>Agathis robusta</i>	Foster Gardens	Ornamental
<i>Philadelphus</i> sp.	Haiku Nursery	Ornamental
<i>Beleperone guttata</i>	Haiku Nursery	Ornamental
<i>Spirea</i> sp.	Haiku Nursery	Ornamental
<i>Ardisia crenulata</i>	Haiku Nursery	Ornamental
<i>Spathiphyllum</i> sp.	Foster Gardens	Ornamental
<i>Begonia</i> sp.	Haiku Nursery	Ornamental
<i>Arum</i> sp.	James C. Lindsay	Ornamental
<i>Musa sapientum</i>	Hawaii Experiment Station	Fruit
<i>Cocus nucifera</i>	Dr. Edward M. Ehrhorn	Fruit
<i>Polypodium phymatodes</i>	James C. Lindsay	Ornamental
<i>Lycopodium</i> sp.	James C. Lindsay	Ornamental
<i>Barringtonia speciosa</i>	Foster Gardens	Ornamental
<i>Asplenium nidus</i>	Foster Gardens	Ornamental
<i>Stenotaphrum secundatum</i> ..	Haiku Nursery	Lawn grass
<i>Zoysia ternifolia</i>	Haiku Nursery	Lawn grass
<i>Anthurium andraeanum</i>	Bowers Tropical Nursery	Ornamental
<i>Araucaria excelsa</i>	Haiku Nursery	Ornamental
<i>Phyllostachys aurea</i>	James C. Lindsay	Ornamental bamboo
<i>Hydychium longicornatum</i>	Foster Gardens	Ornamental
<i>Noronhia emarginata</i>	James C. Lindsay	Sea-shore tree

We are indebted to the Department Quartermaster, Panama Canal Department and the officers and men of the United States Army Transports *Republic* and *Ludington* for the courtesy extended The Panama Canal with reference to the transporting and special care given the plants to and from the Canal Zone.

FINANCIAL STATEMENT

Due to the change in status of the Experiment Gardens from a business to a transit unit, the Gardens lost approximately \$4,216 which had accumulated in the replacement of equipment account. If we had been notified in advance that this money was to be returned to the Treasury if it were not used before the status of the Gardens was changed, it could have profitably been spent to purchase a tractor and several other pieces of necessary equipment. Payment for the tractor which was ordered will now have to be made from next year's allotment.

A statement of revenues and expenses of the Gardens from July 1, 1938 to June 30, 1939, follows:

Expenses—

Gold and Silver pay rolls.....	\$33,349.05
Other expenses.....	10,088.46

Revenue—

Estimate from land agent for net re-	
turns from land rentals.....	\$6,040.00
Garden services.....	16,118.52
Garden sales.....	11,500.00
Annual allotment.....	10,000.00

\$43,437.51

\$43,658.52

The Gardens were slightly better off financially this year than they have been in recent years and by watching expenses closely it was possible to carry on a few experiments and to make a few improvements in the ground.

It is expected that several experiments, which have been held in suspense due to the lack of funds, will be started during the next fiscal year if the expected \$5,000 increase in appropriation is forthcoming.

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